Enhancing LSD Image Classification Techniques: A Literature Review on Classification Techniques

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***Abstract*—With an emphasis on lumpy skin disease (LSD) in cattle and other skin conditions, this paper provides an extensive literature review on current developments in disease detection approaches for livestock. Through the use of ensemble models, hybrid systems, preprocessing approaches, feature ex- traction strategies, and Convolutional Neural Networks (CNNs), researchers have significantly increased the efficiency and accuracy of diagnostic procedures. The review summarizes the results of several studies, stressing the advantages and disadvantages of various strategies and offering information on how well they work in agricultural contexts. Integration of domain expertise with image analysis, employing ensemble models to improve robustness, and investigating pretreatment methods for data improvement are some of the important subjects covered. This research adds to the ongoing efforts to protect animal welfare and agricultural productivity while revolutionizing disease detection procedures by analyzing the most recent advancements in livestock health monitoring.**

I. Introduction

In order to guarantee animal welfare, agricultural output, and the agricultural sector’s financial viability, disease identification and livestock health monitoring are essential. The discipline of machine learning and image processing has witnessed significant developments in recent times, leading researchers to investigate diverse approaches for enhancing the identification and diagnosis of livestock ailments. Their attention has primarily been on skin illnesses and cow ailments. With a focus on various skin illnesses and lumpy skin disease (LSD) in cattle, this literature review attempts to give a thorough summary of contemporary research and advancements in disease detection approaches.

The study starts out by looking at research that use Convolutional Neural Networks (CNNs) to diagnose diseases, demonstrating how well deep learning methods work for deciphering patterns in dermatoscopic images. Furthermore, hybrid systems are investigated, emphasizing the integration of domain knowledge with image analysis for improved diagnostic accuracy. These systems combine CNNs with expert systems.

In addition, the paper highlights the role that feature extraction strategies, preprocessing approaches, and ensemble models have in enhancing the resilience and effectiveness of classifications used in illness detection. Research on certain illnesses, such LSD in cattle and other skin conditions, offers important insights into the difficulties and developments in animal health monitoring.

This literature review attempts to provide insights into the advantages and limitations of various approaches for disease detection in livestock by combining results from several research. In addition, to determine the most effective way to identify skin conditions in animals, particularly LSD.

II. LITERATURE SURVEY

Several studies and works have been done in the field of lumpy skin disease detection and cattle health monitoring most of them deals with IOT sensors and ML models such as CNN.

Mohan, Abishaik et al. proposed a novel approach to improving the accuracy of diagnosing animal diseases, particularly in remote livestock breeding farms. By leveraging Convolutional Neural Networks (CNN), the study focuses on enhancing image analysis and disease classification processes. Through dynamic feature extraction from diseased images, the proposed model aims to deliver precise and efficient disease diagnosis, offering significant benefits to the stockbreeding industry. The research emphasizes the importance of utilizing advanced technologies like CNNs to address the challenges associated with limited technical expertise in remote areas, ultimately contributing to the enhancement of disease diagnosis in livestock. The efficiency of the algorithms through rigorous experi- ments and visualization techniques, enabling a detailed explo- ration of disease characteristics, causes, and potential treat- ment options is evaluated. By emphasizing the significance of CNNs in animal disease diagnosis, the research underscores the potential for advanced technologies to revolutionize dis- ease detection and management in livestock breeding farms. The paper's findings highlight the value of integrating cutting- edge methodologies into the field of animal healthcare, paving the way for more accurate and timely disease diagnosis, par- ticularly in regions with limited access to veterinary expertise. [1]

Bezawit Lake et al. proposed convolutional neural networks and expert systems, to develop a hybrid diagnosis system for cattle diseases. This innovative approach aims to address the challenges faced in timely and accurate diagnosis of live-stock diseases, particularly in regions like Ethiopia where the veterinarian-to-animal ratio is significantly low. By combining image processing with expert systems, the study demonstrates a promising method for diagnosing cattle diseases efficiently and effectively. The system showed an encouraging perfor- mance with an accuracy of 83%, highlighting the potential of AI algorithms in improving livestock management practices. Livestock farming is a crucial component of socio-economic development in Ethiopia, contributing significantly to the country's agricultural output and GDP. However, the potential economic benefits from livestock farming are hindered by factors such as the scarcity of veterinary practitioners and the prevalence of endemic and transboundary diseases. The study emphasizes the importance of quick detection and diagnosis of livestock diseases to prevent outbreaks and enhance the economic benefits of livestock production. By integrating expert systems and image processing using deep learning algorithms, the research offers a novel approach to diagnosing cattle diseases promptly and accurately.

The evaluation of the developed approach indicates that the system effectively diagnoses cattle diseases by acquiring infor-mation through images and text inputs. The study highlights the user-friendliness and validity of symptom descriptions in the diagnosis process. While the correctness of treatment recommendations could be improved by considering additional factors like body mass index, the overall performance and applicability of the proposed system are deemed high. The successful integration of expert systems and image processing using deep learning algorithms showcases the potential of AI technologies in revolutionizing livestock disease diagnosis and management practices, particularly in resource-constrained settings. [2]

Wei, Lisheng et al. introduce an approach to identifying three types of skin diseases: herpes, paederus dermatitis, and psoriasis. The methodology involves image preprocessing, feature extraction using the grey-level co-occurrence ma- trix (GLCM), and classification based on the support vector machine (SVM) method. The study addresses the need for automatic methods to improve the accuracy of diagnosis for multitype skin diseases. By employing image processing techniques, the proposed method effectively extracts texture and color features from skin disease images, leading to a recognition rate of 90% or higher for the identified skin diseases. The paper also compares its results with existing methods, demonstrating a notable improvement in recognition accuracy, particularly for psoriasis, where the proposed method achieved a recognition rate of 95

It emphasizes the need to extract symptoms of diverse skin diseases using modern science and technology, aiming to achieve effective and accurate identification of the types of skin diseases for appropriate treatment based on patients' symptoms. The document outlines various image processing techniques, including image filtering, rotation, segmentation, and the application of the grey-level co-occurrence matrix (GLCM) to extract texture and color features from skin disease images.

A comprehensive approach to skin disease recognition, integrating image processing techniques, feature extraction, and classification methods to effectively identify different types of skin diseases is identified and presented. The proposed method demonstrates significant improvements in accuracy compared to existing methods, laying the groundwork for further advancements in skin disease diagnosis and treatment. The study acknowledges the limitations of focusing on specific types of skin diseases and suggests future research directions to address these limitations and improve the recognition of various skin disease series. [3]

In order to detect lumpy skin disease (LSD) in cattle, Musa Genemo provide a novel deep learning method that uses an Extreme Learning Machine (ELM) classifier to achieve an astounding 90.12% accuracy. Although it signals the promise of sophisticated computational methods for illness identifica-tion, it also highlights significant shortcomings in the area. In particular, a major obstacle is the lack of technological com-puter vision research specifically designed for LSD diagnosis. Further validation against cutting-edge methods and feature selection strategy optimization are also recommended by the study in order to increase the model's practical application in cattle health management and reliability. The agricultural community can use cutting-edge technologies to modernize disease detection and eventually protect the welfare of cattle by addressing these problems.This work represents a significant advancement in the field's efforts to close the gap between the-oretical developments and practical application, advancing the development of more effective and efficient disease detection techniques. [4]

A system that uses a dataset of 600 photos from three kinds of cow diseases—FMD, LSD, and IBK—was proposed by Md. Rony et al. Veterinarians participated in the validation process, which produced a distribution of 250, 200, and 150 photos total for each class. The problem of limited data was addressed by using data augmentation techniques. Convolutional layers, pooling layers, ReLU activation, fully connected layers, and softmax are components of the Convolutional Neural Network (CNN) architecture. VGG-16 and Inception-V3, two more architectures, were also used. With a testing accuracy of 95%, Inception-V3 fared better than the other models, proving its usefulness in the early diagnosis of illnesses in cattle. Farmers no longer need to rely solely on manual observation thanks to the system's reliable automated detection solution. [5]

Wei Z et al. introduced Att-DenseUnet(Attention-Based DenseUnet) a deep learning framework tailored for skin lesion segmentation in dermoscopy images.It does away with the need for laborious preprocessing processes by incorporat- ing an attention module that suppresses artifacts such as hairs and bubbles and focuses on pertinent features. Because DenseBlocks reuse features during the downsampling process, they effectively extract features while minimizing computing costs. Resolution in the upsampling pipeline is restored using transposed convolution and basic upsampling procedures. Overfitting is avoided and robustness is improved by adversarial training. Experimental results on the PH2 and ISBI2016 datasets show state-of-the-art performance in terms of sensitivity, time efficiency, accuracy, and Jaccard index. Lesions of different sizes and shapes can be effectively segmented using Att-DenseUnet, even in low-contrast images with fuzzy borders. However, it must solve issues with under- and over-segmentation by utilizing the attention module's residual connections. [6]

Omolbanin Yazdanbakhsh et al. put forward the concept of employing animals' mounted devices coupled with sophisticated surveillance techniques to autonomously and continuously monitor the health status of individual cattle. This innovative approach aimed to leverage presumptive sensors integrated into wearable devices to provide real-time insights into the well-being of livestock. However, their findings revealed that utilizing the wavelet domain of an ensemble classifier yielded a sensitivity of only 80.8% and a specificity of 80%. One notable limitation identified in their system was its reliance on expensive sensor devices and a wired infrastructure, compounded by the need for continuous computer monitoring.

Although this technology has the potential to improve animal health monitoring, its broad adoption is hindered by the large costs associated with sensor equipment and the logistical difficulties of maintaining a connected system. Therefore, even while the idea is a significant step forward in the monitoring of livestock, further study and technology development are needed to overcome these obstacles and make it easier for these systems to be smoothly incorporated into farming oper- ations. [7]

Dr. T. Kameswara Rao et al. considered convolutional neural networks (CNNs) and ensemble models for skin disease identification, the suggested system makes use of architectures including VGG16, DenseNet, and Inception that were trained on the HAM10000 dataset. The accuracy of individual models varies from 71% to 85%, while the ensemble achieves 85.02%, suggesting that the combination of models results in improved performance. Limitations include the inability to detect absence of disease, potential disagreements in diagnoses, specificity limited to seven diseases, and dataset variety reducing accuracy. Upcoming enhancements include enhancing illness detection capabilities, connecting with telemedicine for remote consultations, and improving dataset diversity. Although it shows potential, further research and improvement are required to overcome these drawbacks and increase the applicability of skin disease diagnosis. [8]

III. RESULTS AND DISCUSSIONS

The review reveals the diversity of methods used in the field of disease detection and monitoring in livestock, with a special emphasis on skin disorders and lumpy skin disease (LSD) in cattle. The effectiveness of Convolutional Neural Networks (CNNs) in detecting animal diseases is noteworthy, as research by Mohan, Abishaik et al., and Bezawit Lake et al. emphasize the potential for modern technology to increase disease detection processes in remote livestock breeding farms.

Furthermore, studies by Wei, Lisheng et al. and Wei Z et al. present novel methods for utilizing deep learning frameworks and image processing techniques to identify and segment skin disorders. These approaches show notable gains in accuracy over current approaches, suggesting encouraging progress toward more successful and efficient illness diagnosis and treatment.

Nonetheless, issues including the variety of datasets, the specificity of illness identification, and technology constraints are evident in all of the research that were surveyed. For example, the specificity of disease detection algorithms may restrict their applicability to a wider range of situations, while the lack of diverse datasets may affect the accuracy of machine learning models. Furthermore, as noted by Omolbanin Yazdanbakhsh et al., a major obstacle to the widespread adoption of livestock monitoring systems is the dependence on costly sensor devices and wired infrastructures.

In conclusion, a variety of elements, such as the particular context, dataset features, and performance measures, determine the "best" approach for disease identification in livestock. Nonetheless, the literature study indicates that a number of techniques show noteworthy efficacy:

Convolutional Neural Networks (CNNs): CNNs are a highly effective technique for detecting diseases in livestock and skin conditions. By using deep learning algorithms, they are able to accurately classify image data by extracting significant features.

Hybrid Systems: Bezawit Lake et al.'s methods, which fuse CNNs and expert systems, provide a thorough solution by fusing domain expertise with image analysis. The accuracy and interpretability of disease diagnosis are improved by this combination.

Ensemble Models: Dr. T. Kameswara Rao et al. use ensemble models, which combine the advantages of several base models to enhance performance as a whole. Ensemble approaches improve robustness and generalization capacity by combining predictions from many designs.

Techniques for Extraction of Features: Wei, Lisheng et al. used GLCM-based feature extraction, which is an efficient way to extract texture and color information from photos of skin diseases, thus improving discriminative capability.

While each method has its benefits, the best strategy for a given application would need to be determined after a thorough analysis taking into account variables like accuracy, computational efficiency, and scalability. Furthermore, combining several techniques or utilizing hybrid approaches could improve the precision and dependability of detection even more.

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